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2000

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856

KANSAS STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
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Southwest Research-Extension Center

ECONOMIC COMPARISON OF BT-CORN REFUGE-PLANTING STRATEGIES FOR SOUTH CENTRAL AND SOUTHWESTERN KANSAS

by

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SUMMARY

Data from Bt corn trials at Garden City and St. John, KS were analyzed to compare the potential economic returns of various Bt corn refuge-planting strategies. The results of this analysis indicate that the costs of the refuge-planting strategies are relatively small in comparison with the increased returns associated with Bt corn.

INTRODUCTION

The Environmental Protection Agency is now requiring producers who grow Bt-corn to plant a 20% refuge as a resistance management practice. This study was an attempt to determine the economic cost to producers of various refuge strategies. The analysis was based on selected data from Bt-corn efficacy trials conducted in St. John and Garden City, KS during 1997 and 1998 comparing corn hybrids under both insecticide sprayed and unsprayed conditions. Costs associated with the inconvenience of having to plant the refuge are not included.

PROCEDURES

Five pairs of non-Bt and Bt corn hybrids (Table 1) were selected from these trials to obtain representative yield information for four corn growing strategies; unsprayed non-Bt corn, insecticide-sprayed non-Bt corn, unsprayed Bt corn, and insecticide-sprayed Bt corn. The insecticide treatment used in the trials was Capture at 0.08 lb ai/A applied for corn borer control. Capture at this rate also would reduce spider mites and corn rootworm adults if present. These hybrids were used in all four studies. The events MON810 or Bt11 (sold under the Trademark YieldGard) were chosen for this comparison because they provide very good control of southwestern corn borer and are available in corn hybrids that are well-adapted for this area. In these trials, both standing yield and fallen yields were recorded. The corn in these trials was harvested in October, so there was a reasonable chance of lodging from corn borer damage. Standing yield was from plants that did not lodge from corn borer damage and represented the yield that could be expected, if fields were harvested late and lodging was extensive. Total yield was the sum of the standing yield plus the hand-harvested yield from any lodged plants or dropped ears. It represented the overall physiological yield including corn borer losses associated with early harvest.

RESULTS AND DISCUSSION

Yield data for the four corn growing strategies are summarized in Table 2. A significant difference (DMRT at 0.05) occurred between standing yields of

Table 1. Corn hybrids selected from Bt corn trials conducted near St. John and Garden City, KS during 1997 and 1998.

Company	Bt Hybrid — Event	Paired Non-Bt Hybrid
Novartis	7590Bt — Bt11	7590
Novartis	7639Bt — Bt11	4494
Golden Harvest	H-2530Bt – MON810	H-2530
Cargill	8021BT – MON810	7997
Pioneer	31A14 – MON810	3162

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the unsprayed non-Bt corn and the sprayed non-Bt corn. In addition, both the unsprayed and sprayed Bt corn yielded significantly more than the sprayed non-Bt corn. Similar significant differences also were observed in total yield among the four treatments.

To determine economic returns selected in corn production systems, the effects of seed costs, insecticide plus application costs, and yields were considered. The cost of Bt corn was $1.53/1000 seeds versus $1.21/1000 seeds for non-Bt corn, for a technology fee of $0.32/1000 seeds. On a per acre basis, the cost of Bt-corn was $10.24 higher than that of non-Bt corn. The total cost of applying 0.08 lbs of Capture at $429/gal was $21.20/a, when an application cost of $4.04/a was added. The price of grain was set at $2.40/bu, which was the average harvest price paid in southwest Kansas during 1997-98. The differences in yields and returns for the various corn production strategies are shown in Table 3. Significant differences in yields resulted in higher returns for most corn production strategies. However, the small increase in yield gained from spraying Bt-corn versus not spraying Bt-corn was offset by the cost of spraying. Thus, a small loss in returns occurred where Bt-corn was sprayed with Capture.

These data were employed to estimate potential returns for several recommended non-Bt corn refuge strategies (Table 4). Two conclusions stand out. First, corn growers in southwest and south central Kansas can experience significant losses in returns when nothing is done to control corn borers. Based on standing yields, returns were increased by 15% when timely applications of Capture were made and by from 22 to 27% when various Bt corn strategies were employed. The other interesting observation is that the economic cost of including a 20% or a 40% non-Bt corn refuge-planting was fairly low. The difference in returns for the refuge strategies ranged from only 2 to 4%. Trends were similar when total yields (standing + lodged) were analyzed. Assessing total yields rather than standing yields may be more representative of expected losses, if corn is harvested before any lodging is caused by corn borers. All of the various Bt corn and non-Bt corn refuge combinations exhibited

Table 2. Average corn yields for five Bt corn hybrids and five non-Bt corn hybrids under insecticide sprayed or unsprayed conditions near Garden City and St. John, KS during 97 and 98.

Hybrid	Standing Yield (Bu/A)		Total Yield (Bu/A)	
	Unsprayed	Sprayed	Unsprayed	Sprayed
Non-Bt	138.8 a	168.1 b	163.4 a	175.3 b
Bt	180.5 c	189.2 c	183.0 c	190.4 c

Table 3. Selected comparisons of corn productions strategies showing yield differences and resulting dollar differences on a per acre basis.

Advantage of Strategy Listed Below	Standing Yield (Bu/A) and Cost		
	Vs Unsprayed Non-Bt	Vs Sprayed Non-Bt	Vs Unsprayed Bt
Sprayed Non-Bt	29.3 ($49.12)	—	—
Unsprayed Bt	41.7 ($89.84)	12.4 ($40.72)	—
Sprayed Bt	50.4 ($89.52)	21.1 ($40.40)	8.7 (-$0.32)
Advantage of Strategy Listed Below	**Total Yield (Bu/A) and Cost**		
	Vs Unsprayed Non-Bt	Vs Sprayed Non-Bt	Vs Unsprayed Bt
Sprayed Non-Bt	11.9 ($7.36)	—	—
Unsprayed Bt	19.6 ($36.80)	7.7 ($29.44)	—
Sprayed Bt	27.0 ($33.36)	15.1 ($26.00)	7.4 (-$3.44)

Table 4. Comparison of returns to different corn production systems based on data from trials conducted near St. John and Garden City, KS during 1997 and 1998.

Production System [a]	Total Returns	Increase in Returns [a]	% Increase [b]	% Decrease [c]
	Comparison Based on Standing Yields			
100 acres of unsprayed non-Bt Corn	$33,312.00	—	—	—
100 acres of sprayed non-Bt Corn	$38,224.00	$4,912.00	14.75%	—
20 acres of unsprayed non-Bt corn plus 80 acres of unsprayed Bt corn	$40,499.20	$7,187.20	21.58%	4.25%
20 acres of sprayed non-Bt corn plus 80 acres of unsprayed Bt corn	$41,481.60	$8,169.60	24.52%	1.93%
40 acres of sprayed non-Bt corn plus 60 acres of unsprayed Bt corn	$40,667.20	$7,355.20	22.08%	3.85%
20 acres of sprayed non-Bt corn plus 80 acres of sprayed Bt corn	$41,456.00	$8,144.00	24.45%	1.99%
100 acres of unsprayed Bt corn	$42,296.00	$8,984.00	26.97%	—
100 acres of sprayed Bt corn.	$42,264.00	$8,952.00	26.87%	—
	Comparison Based on Total Yield			
Production System	Total Returns	Increase in Returns [a]	% Increase [b]	% Decrease [c]
100 acres of unsprayed non-Bt Corn	$40,850.00	—	—	—
100 acres of sprayed non-Bt Corn	$41,725.00	$736.00	1.88%	—
20 acres of unsprayed non-Bt corn plus 80 acres of unsprayed Bt corn	$43,970.00	$2,944.00	7.51%	1.72%
20 acres of sprayed non-Bt corn plus 80 acres of unsprayed Bt corn	$44,145.00	$3,091.20	7.88%	1.37%
40 acres of sprayed non-Bt corn plus 60 acres of unsprayed Bt corn	$43,540.00	$2,502.40	6.38%	2.75%
20 acres of sprayed non-Bt corn plus 80 acres of sprayed Bt corn	$43,945.00	$2,816.00	7.18%	2.01%
100 acres of unsprayed Bt corn	$44,750.00	$3,680.00	9.38%	—
100 acres of sprayed Bt corn.	$44,500.00	$3,336.00	8.51%	—

[a] These production systems included 20% or 40% refuge-planting of non-Bt corn or none. (The EPA currently requires a 20% refuge-planting).
[b] Relative to 100% unsprayed non-Bt corn.
[c] Relative to 100% unsprayed Bt corn.

higher returns than either unsprayed or sprayed non-Bt corn. Returns obviously vary as the cost of inputs and price paid for corn grain changes. As the price of corn increases or as the costs of control decrease, the returns for the sprayed options improve in relative terms. If the technology fees decline and other factors remain constant**,** then the returns for Bt corn grow even higher. However, the percentage differences in economic returns appear to remain fairly stable among a fairly wide range of economic inputs.

This analysis highlights the importance of controlling corn borers and the potential advantages of using Bt corn−hybrids as part of a corn borer management system. These data also indicate that refuge-plantings should not cause a significant reduction in economic returns. Returns from the

refuge-planting systems were within 1 to 4% of returns expected for field wide use (100% plantings) of Bt corn (using data from either standing or total yields) and were still 4 to 6% above returns from the standard practice of using an insecticide to protect non-Bt hybrids from corn borers (using the total yield data, which is a more conservative estimate of corn borer injury).

A significant portion of the data used to develop this report originated from studies sponsored in part by K-State Research and Extension and the Kansas Corn Commission.

Center Strip as Refuge (25-50%)